IN THE CLAIMS:

Please amend claims as follows.

1. (Currently amended) A signal processing system used in automobile to suppress noise from a speech signal comprising:

a first signal detector configured to provide a first signal comprised of a desired component plus an undesired component, wherein the desired component includes speech;

a second signal detector configured to provide a second signal comprised mostly of an undesired component; and

a signal processor operatively coupled to the first and second signal detectors and configured to ~~receive and~~ process the first and second signals based on a cancellation technique to remove correlated undesired component and further based on at least one noise suppression technique to remove uncorrelated undesired component and to provide an output signal having a substantial portion of the desired component and a large portion of the undesired component removed.

2. (Original) The system of claim 1, wherein the first signal detector is a microphone configured to detect speech.

3. (Original) The system of claim 1, wherein the second signal detector is a sensor configured to detect automobile vibration.

4. (Original) The system of claim 1, wherein the second signal detector is a sensor configured to detect mostly noise.

5. (Currently amended) The system of claim 1, wherein the signal processor includes

an adaptive canceller configured to ~~receive~~ process the first and second signals in accordance with a set of coefficients for the cancellation technique, ~~and~~ to provide an intermediate signal having a portion of the undesired component in the first

signal that is correlated with the undesired component in the second signal removed, and to adjust the set of coefficients using the intermediate signal.

6. (Original) The system of claim 5, wherein the adaptive canceller implements a normalized least mean square (NLMS) algorithm.

7. (Original) The system of claim 5, wherein the adaptive canceller is implemented in a time domain.

8. (Original) The system of claim 5, wherein the adaptive canceller is implemented in a frequency domain.

9. (Original) The system of claim 5, wherein the signal processor further includes

a voice activity detector configured to receive the intermediate signal from the adaptive canceller and provide a control signal indicative of non-active time periods whereby the desired component is detected to be absent from the intermediate signal.

10. (Original) The system of claim 1, wherein the signal processor includes:

a noise suppression unit configured to receive and process the first and second signals to suppress the undesired component in the first signal, and to provide the output signal.

11. (Original) The system of claim 10, wherein the noise suppression unit is configured to suppress the undesired component in the first signal based on a two-channel spectrum modification technique using the first and second signals.

12. (Currently amended) The system of claim 1~~10~~, wherein the signal processor includes:

a noise suppression unit ~~is~~ configured to suppress the undesired component in the first signal based on a single-channel spectrum modification technique using the first signal.

13. (Currently amended) The system of claim 1 ~~10~~, wherein the signal processor includes:

a noise suppression unit ~~is~~ configured to suppress residual undesired component in the first signal based on a status of a voice activity detector.

14. (Original) The system of claim 10, wherein the noise suppression unit is configured to suppress the undesired component in the first signal in a frequency domain.

15. (Original) The system of claim 1 and configured for installation in an automobile.

16. (Currently amended) The system of claim 1 ~~15~~, wherein the signal processor includes: ~~undesired component in the second signal includes vibration noise~~

a first noise suppression unit configured to process the first and second signals based on a two-channel spectrum modification technique to suppress the undesired component in the first signal, and

a second noise suppression unit configured to suppress the undesired component in the first signal based on a single-channel spectrum modification technique.

17. (Currently amended) The system of claim 1 ~~15~~, wherein the signal processor includes: ~~undesired component in the second signal includes engine and road noise~~

a first noise suppression unit configured to process the first and second signals based on a two-channel spectrum modification technique to suppress the undesired component in the first signal, and

a second noise suppression unit configured to suppress residual undesired component in the first signal.

18. (Original) The system of claim 1, wherein the desired component in the first signal is speech.

19. (Currently amended) A signal processing system comprising:

a first signal detector configured to provide a first signal comprised of a desired component plus an undesired component;

a second signal detector configured to provide a second signal comprised mostly of an undesired component;

an adaptive canceller configured to receive and process the first and second signals, ~~and~~ to remove a portion of the undesired component in the first signal that is correlated with the undesired component in the second signal, and to provide an intermediate signal;

a voice activity detector configured to receive the intermediate signal and provide a control signal indicative of non-active time periods whereby the desired component is detected to be absent from the intermediate signal; and

a noise suppression unit configured to receive the intermediate and second signals, ~~and~~ to suppress ~~the~~ uncorrelated undesired component in the intermediate signal based on a spectrum modification technique, and to provide an output signal having a substantial portion of the desired component and a large portion of the undesired component removed.

20. (Original) The system of claim 19, wherein the adaptive canceller is configured to adaptively cancel the correlated portion of the undesired component based on a linear transfer function.

21. (Original) The system of claim 19, wherein the adaptive canceller is configured to adaptively cancel the correlated portion of the undesired component based on a non-linear transfer function.

22. (Original) The system of claim 19, wherein the noise suppression unit is configured to suppress the undesired component in the intermediate signal based

on a two-channel spectrum modification technique using the intermediate and second signals.

23. (Currently amended) The system of claim 22, wherein the noise suppression unit includes

a noise spectrum estimator configured to receive the intermediate and second signals and provide spectrum estimates of the desired component in the intermediate signal and the undesired component in the second signal,

a gain calculation unit configured to receive the spectrum estimates and provide a set of gain coefficients, and

a ~~first~~ multiplier configured to ~~multiple~~ multiply magnitude of a transformed intermediate signal with the set of gain coefficients.

24. (Original) The system of claim 19, wherein the noise suppression unit is configured to suppress the undesired component in the intermediate signal based on a single-channel spectrum modification technique using the intermediate signal.

25. (Currently amended) The system of claim 24, wherein the noise suppression unit includes

a noise spectrum estimator configured to receive the intermediate signal and provide spectrum estimates of the undesired component and the desired component in the intermediate signal,

a gain calculation unit configured to receive the spectrum estimates and provide a set of gain coefficients, and

a multiplier configured to ~~multiple~~ multiply magnitude of a transformed intermediate signal with the set of gain coefficients.

26. (Original) The system of claim 19, wherein the noise suppression unit is configured to suppress residual undesired component in the first signal based on spectral analysis of the intermediate signal.

27. (Currently amended) The system of claim 26, wherein the noise suppression unit includes

a noise suppressor configured to receive the control signal from the voice activity detector and provide a set of gain coefficients, and

a multiplier configured to ~~multiple~~ multiply magnitude of a transformed intermediate signal with the set of gain coefficients.

28. (Original) The system of claim 19 and configured for installation in an automobile.

29. (Withdrawn) A voice activity detector for use in a noise suppression system, comprising:

a first unit configured to receive and transform an input signal to provide a transformed signal comprised of a sequence of blocks of M elements for M frequency bins, one block for each time instant, and wherein M is two or greater;

a second unit configured to provide a power value for each element of the transformed signal;

a third unit configured to receive power values for the M frequency bins and provide a reference value for each of the M frequency bins, wherein the reference value for each frequency bin is a smallest power value received within a particular time window for the frequency bin plus a particular offset;

a fourth unit configured to compare the power value for each frequency bin against the reference value for the frequency bin and provide a corresponding output value; and

a fifth unit configured to provide a control signal indicative of activity in the input signal based on output values for the M frequency bins.

30. (Withdrawn) The voice activity detector of claim 29, wherein the first unit implements a fast Fourier transform (FFT) on the input signal.

31. (Withdrawn) The voice activity detector of claim 29, wherein the third unit includes

a first lowpass filter configured to receive and filter power values for each of the M frequency bins to provide a respective sequence of first filtered values for the frequency bin,

a delay line unit configured to receive and store a plurality of first filtered values for each of the M frequency bins,

a selection unit configured to select a smallest first filtered value stored in the delay line unit for each of the M frequency bins, and

a summer configured to add the particular offset to the smallest first filtered value for each frequency bin to provide the reference value for the frequency bin.

32. (Withdrawn) The voice activity detector of claim 31, wherein the third unit further includes

a second lowpass filter configured to receive and filter the power values for each of the M frequency bins to provide a respective sequence of second filtered values for the frequency bin, and

wherein the fourth unit is configured to compare the second filtered value for each frequency bin against the reference value for the frequency bin.

33. (Withdrawn) The voice activity detector of claim 29, wherein each output value from the fourth unit is a hard-decision value, and wherein the fifth unit includes

an accumulator configured to accumulate the output values from the fourth unit, and

a comparator configured to compare an accumulated output from the accumulator against a particular threshold, and wherein the control signal indicates activity in the input signal if the accumulated output is greater than the particular threshold.

34. (Currently amended) A method for suppressing noise in an automobile, comprising:

detecting via a first signal detector a first signal comprised of a desired component plus an undesired component;

C
o

detecting via a second signal detector a second signal comprised mostly of an undesired component;

removing a portion of the undesired component in the first signal that is correlated with the undesired component in the second signal based on adaptive cancellation; and

removing an additional portion of the undesired component in the first signal that is uncorrelated with the undesired component in the second signal based on spectrum modification to provide an output signal having a substantial portion of the desired component and a large portion of the undesired component removed.

35. (Withdrawn) A method for detecting activity in an input signal, comprising:

transforming the input signal to provide a transformed signal comprised of a sequence of blocks of M elements for M frequency bins, one block for each time instant, and wherein M is two or greater;

deriving a power value for each element of the transformed signal;

deriving a reference value for each of the M frequency bins, wherein the reference value for each frequency bin is a smallest power value received within a particular time window for the frequency bin plus a particular offset;

comparing the power value for each frequency bin against the reference value for the frequency bin to provide a corresponding output value; and

providing a control signal indicative of activity in the input signal based on output values for the M frequency bins.